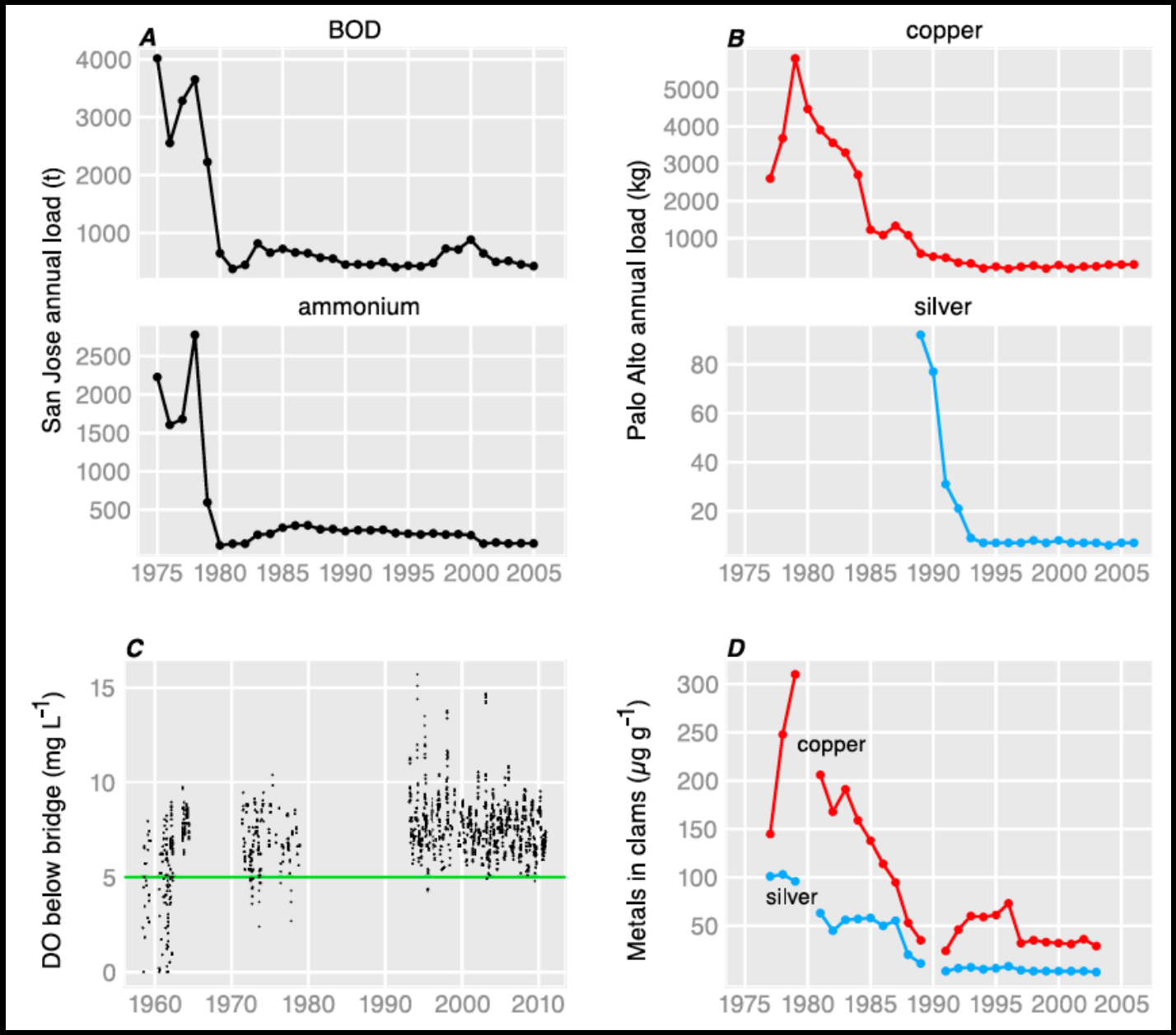
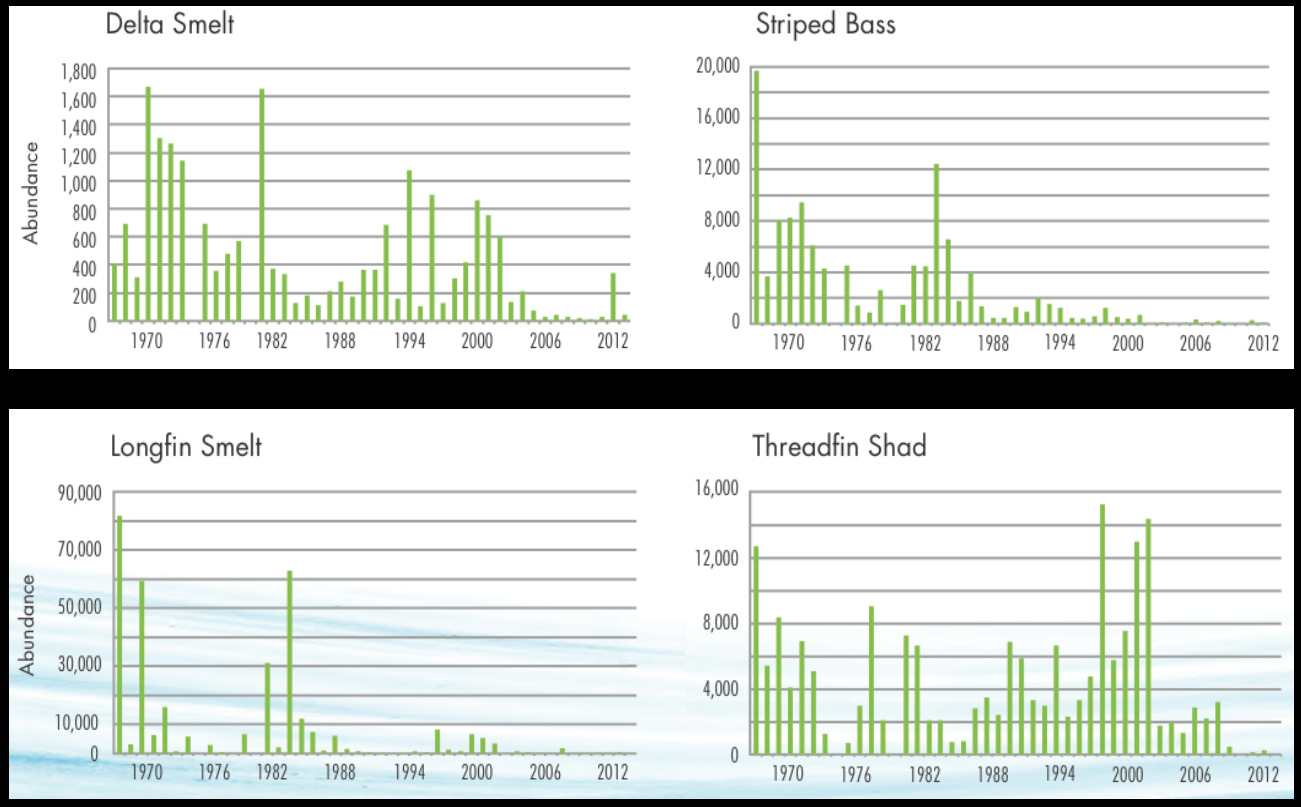
We Have Solved Some Environmental Problems



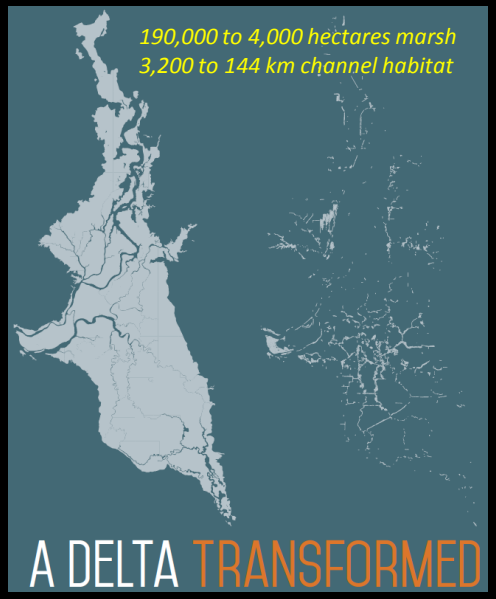
Cloern & Jassby 2012

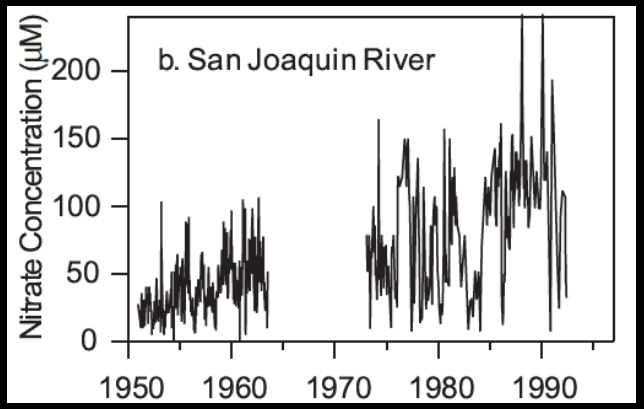
Why is this a harder problem?

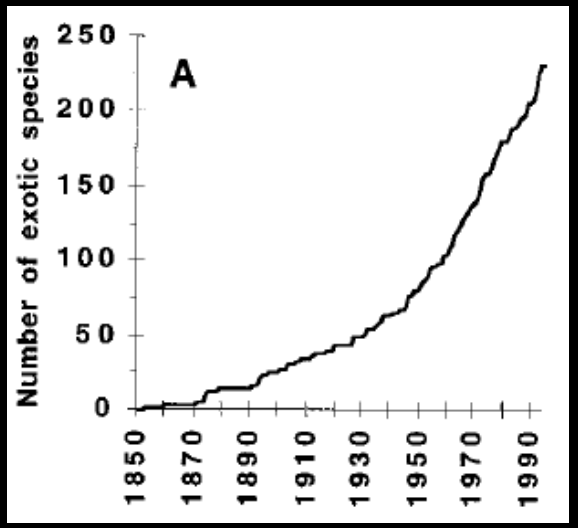


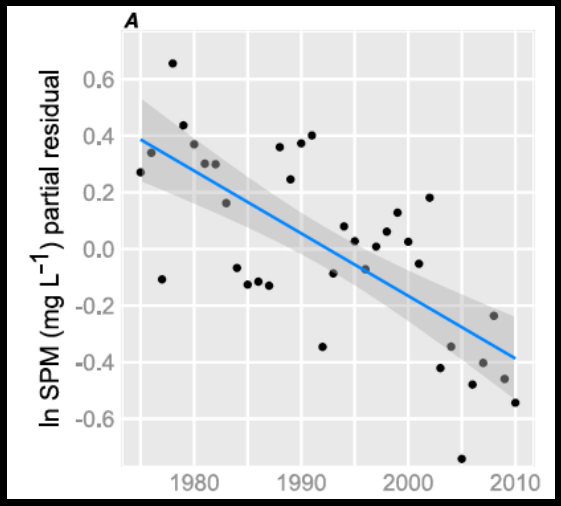
SFEI 2013

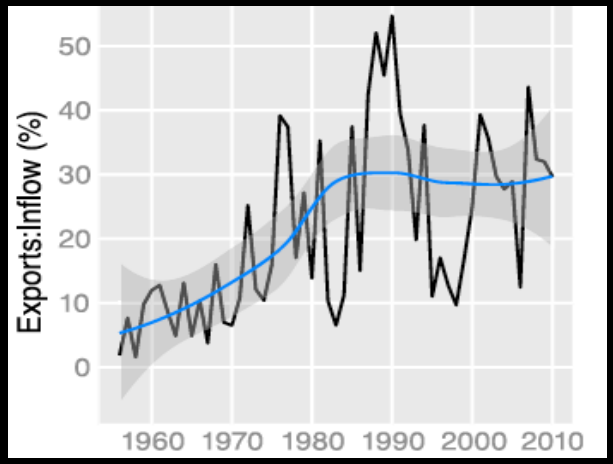
1. Multi-dimensional problem

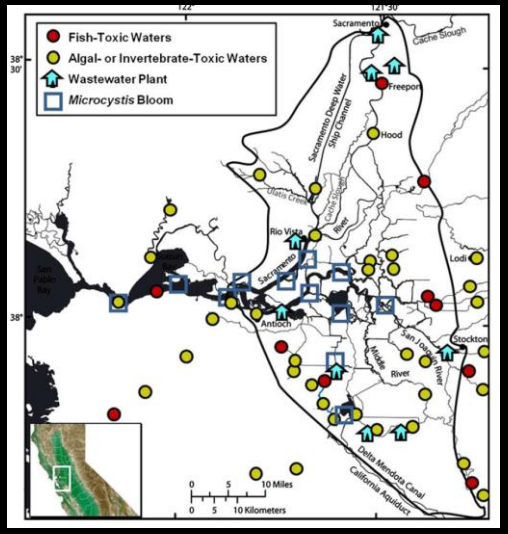












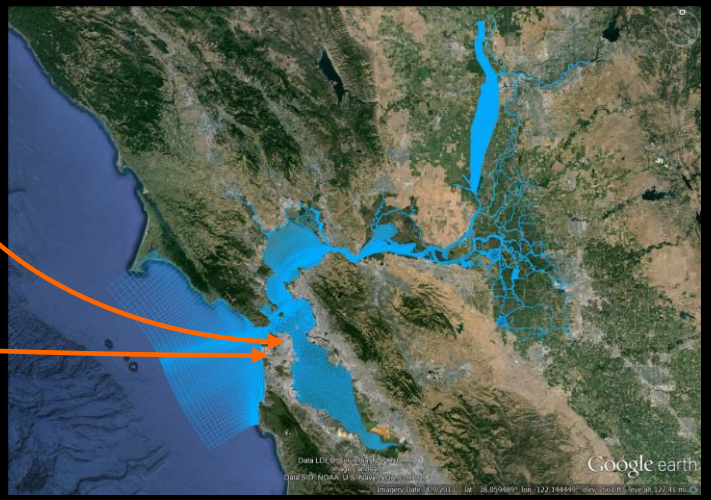
2. Not a local problem

Global Circulation Models

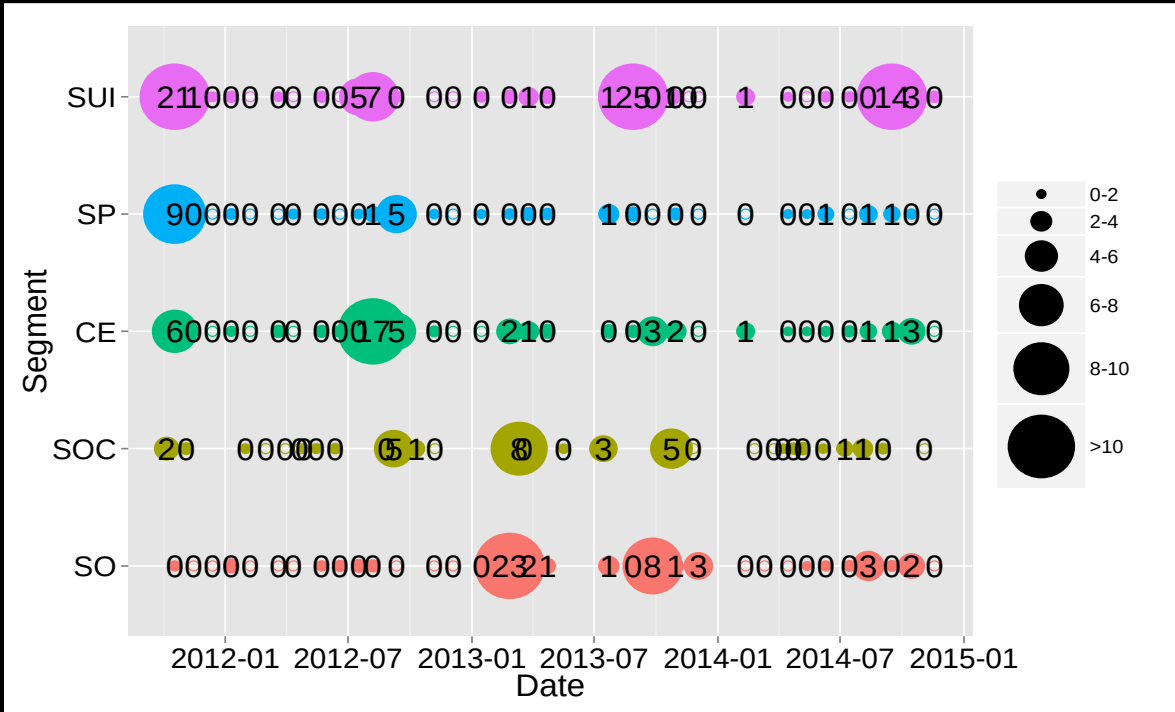
Downscaled to Region

Watershed Model

Sea Level – Golden Gate

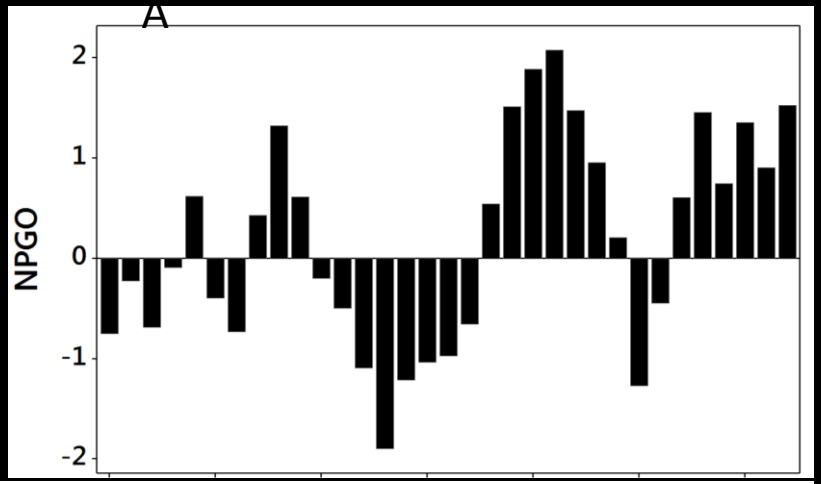


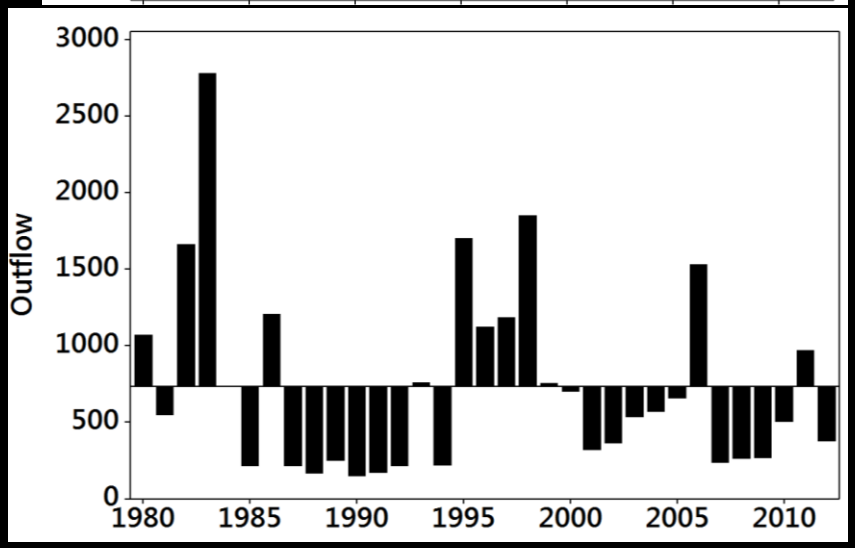
2a. Corollary: the world doesn't end at Carquinez Strait



Microcystin is present in the Bay, downstream
of its Delta source (Kudela data, to be published)

3. Different climate effects over oceans and land





137 fish species

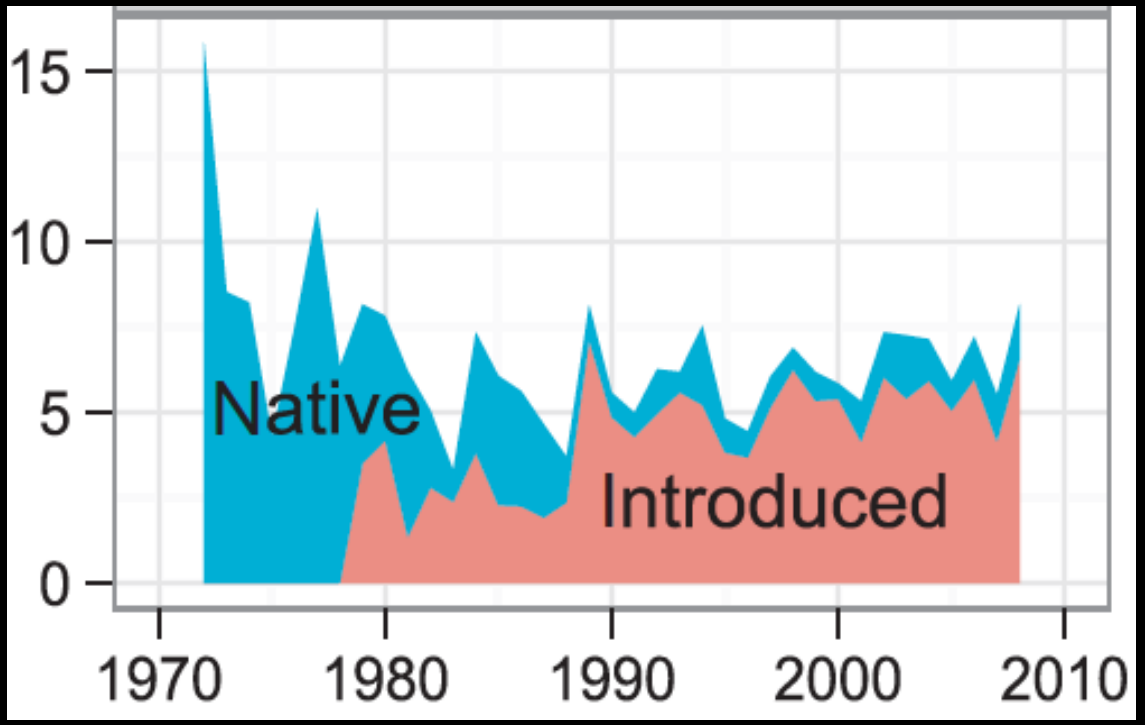
	Demersal Fish	*Pelagic Fish*
NPGO	English Sole + White Croaker -	Northern Anchovy - Pacific Herring -
Delta Outflow	Pacific Staghorn Sculpin + Speckled Sandab +	Longfin Smelt + Striped Bass +

Feyrer et al. submitted

4. Fast changes

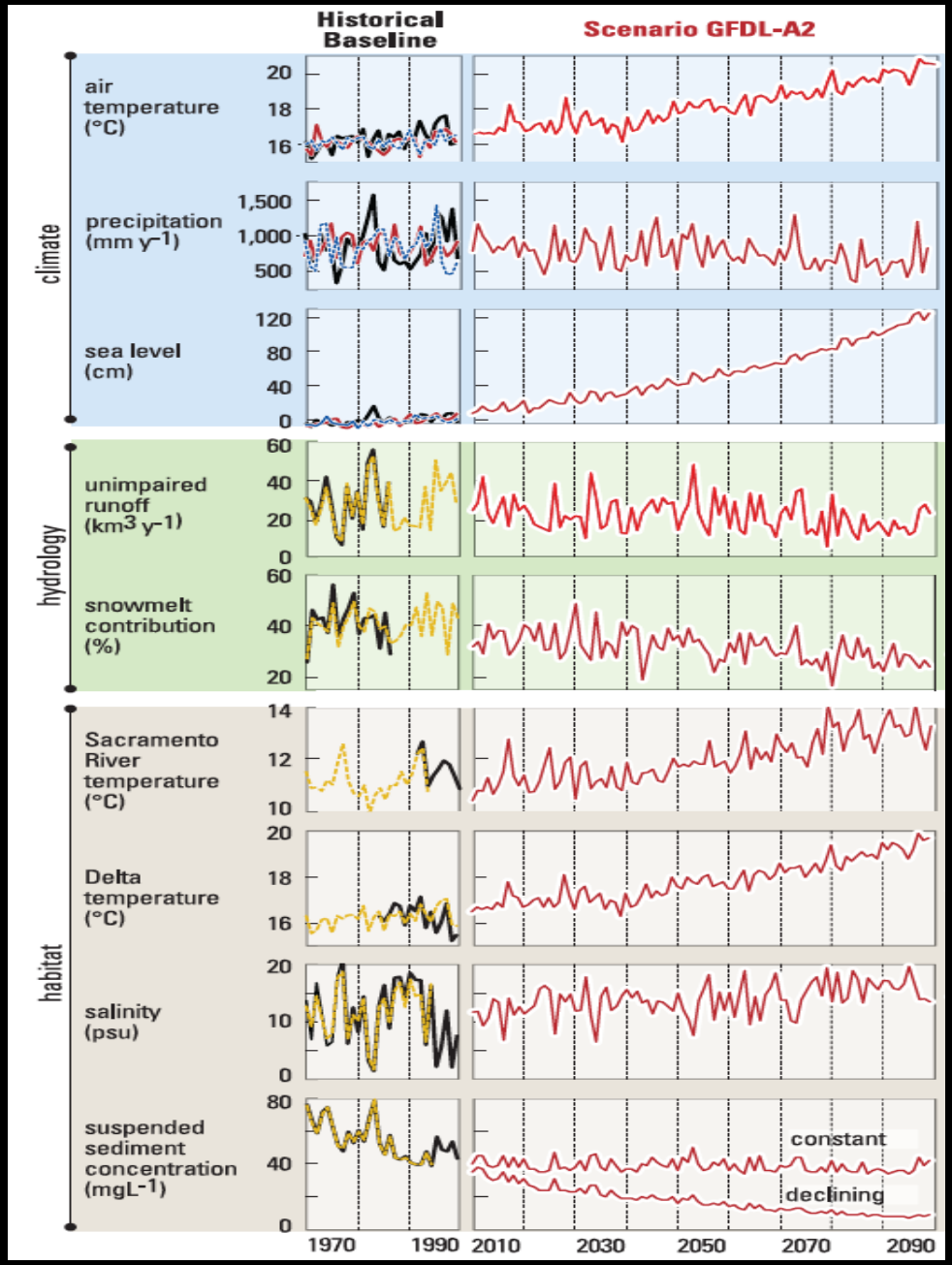
we are changing Earth more rapidly
than we are understanding it

(Vitousek et al. 1997)



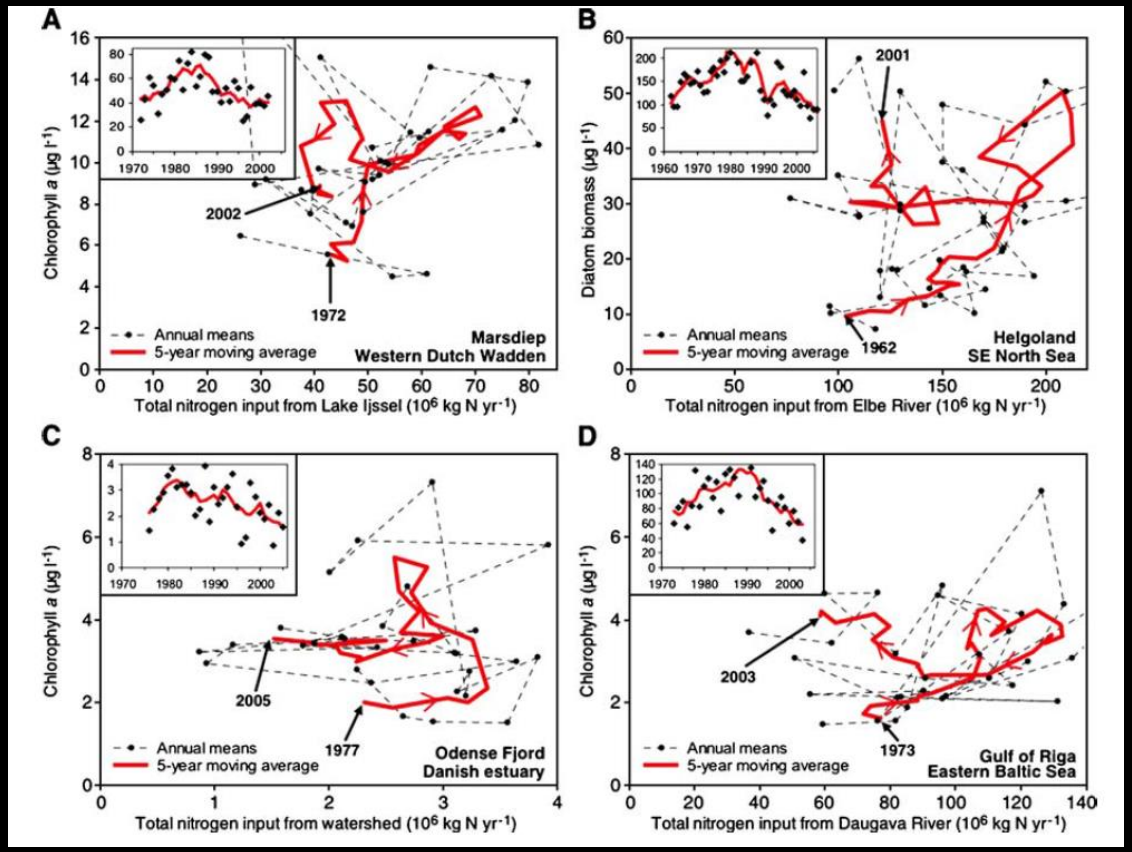
Winder et al. 2011

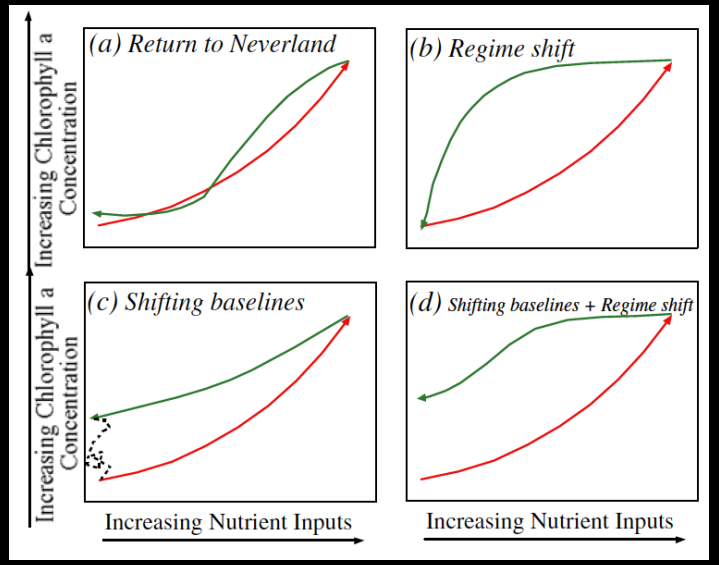
5. Change doesn't let up



Cloern et al. 2011

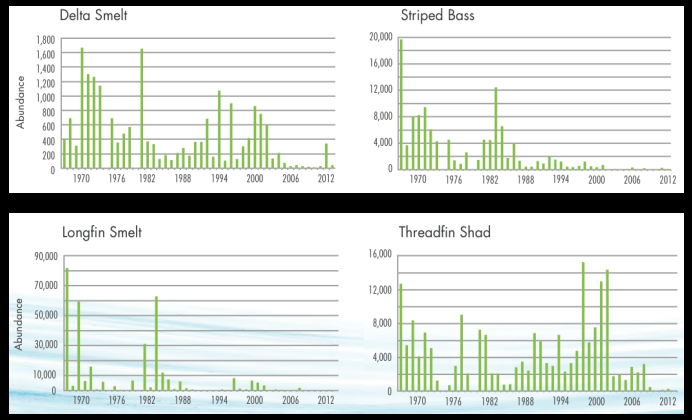
6. Complex, nonlinear dynamics





Duarte et al. 2009

A wicked-hard problem



Multi-dimensional problem

Local + regional + global problem

Different climate effects over oceans and land

Fast changes

Change is continuous

Complex, nonlinear dynamics